

## Abstract

AISI H13 tool steel is a hot work tool steel which contains chromium, molybdenum and vanadium as main alloying ingredients and is commonly used in hot forming operations like die casting and forging. During hot forming of aluminum alloys, dies made up of hot work tool steels get exposed to severe operating conditions like thermal and mechanical fatigue, high pressure and high erosion from flowing molten alloy, resulting in surface damages like heat checks, erosion and chemical attack in prime locations and thereby, limiting the service life of tools. Laser, as a source of monochromatic and coherent radiation has a wide scope of application in surface engineering. In the present study, a detailed investigation has been made to understand the effect of process parameters on the microstructures (grain size, morphology, and phase distribution) and mechanical properties (tensile behavior, microhardness and wear resistance) to optimize the process parameters for laser surface hardening. In an another attempt, laser cladding of near equivalent composition as that of AISI H13 tool steel was developed on hardened and tempered AISI H13 tool steel substrate under a wide range of laser parameters and the effect of process parameters and post clad tempering treatments on the microstructures (grain size, morphology and phase distribution), and mechanical properties (microhardness, micro-tensile behavior and wear resistance) has been investigated in details to optimize the process parameters for laser cladding and post clad tempering heat treatment. Finally, the tempering (softening) resistance and thermal fatigue behavior of the laser surface hardened and laser clad zone were evaluated under simulated environment in liquid aluminum alloy for understanding the suitability of the laser surface hardened and laser clad zone for application in aluminum die casting dies.

From the present study it is concluded that laser surface hardening can offer several advantages including development of refined martensite microstructure with uniform fine carbide particles dispersion. The results are encouraging towards application of laser surface engineering by laser surface hardening and laser surface cladding to improve and extend the die tool life for hot forming application. Laser cladding is also an effective tool to refurbish and repair damaged part in service with improved properties and hence, ensure an enhanced service life.

